CLAIMS

1   1.   A method for creating a three-dimensional visual representation of an object

2   having multiple resolutions, comprising the steps of:

3   retrieving coordinates of vertices for the object;

4   determining a collapse order for the vertices identified in the vertex list;

5   reordering the vertices identified in the vertex list responsive to the

6   determined collapse order;

7   creating a vertex collapse list responsive to the collapse order where the

8   vertex collapse list specifies, for a target vertex, a neighbor vertex

9   to collapse to;

10   using the vertex collapse list and a level of detail to identify at least one

11   display vertex of the object; and

12   rendering the display vertex to produce a three-dimensional visual

13   representation of the object.

1   2.   The method of claim 1 wherein determining the collapse order comprises the steps

2   of:

3   determining a set of collapse paths;

4   selecting a collapse path from the set of collapse paths;

5   computing visual distortion factors for the selected collapse path;

6   responsive to the computed visual distortion factors, determining a

7   collapse value for the selected collapse path;

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8 repeating selecting a collapse path, computing visual distortion factors,

9   determining a collapse value for each collapse path;

10 selecting a next vertex to be collapsed as a vertex having a collapse path

11   causing the least visual distortion to the object;

12 collapsing the next vertex to be collapsed along the corresponding collapse

13   path; and

14 repeating the above steps until a minimum resolution level is attained.

1 3. The method of claim 2 wherein computing visual distortion factors comprises the

2 steps of:

3 computing an area change factor for the selected collapse path;

4 computing an angular deviation factor for the selected collapse path; and

5 computing a local volume change factor for the selected collapse path.

1 4. The method of claim 3 wherein the computing an area change factor for each

2 collapse path further comprises:

3 computing an area of the object after collapsing the target vertex along the

4   collapse path; and

5 subtracting the computed area from an area of the object prior to the

6   collapse.

1 5. The method of claim 3 wherein the computing a volume change factor for the

2 selected collapse path comprises:

3 computing a volume of the object after collapsing the target vertex along

4   the collapse path;

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5   subtracting the computed volume from a volume of the object prior to the

6   collapse.

1   6.   The method of claim 5, wherein the step of computing a volume further

2   comprises:

3   selecting the target vertex to be an apex for a pyramid;

4   forming a base of the pyramid from a triangle connecting three

5   consecutive neighbor vertices to the target vertex;

6   computing a volume of the pyramid;

7   constructing a next pyramid from a next set of three consecutive neighbor

8   vertices;

9   computing a volume of the next pyramid;

10   repeating the constructing a next pyramid and computing a volume steps

11   for all unique three consecutive neighbor vertex sets; and

12   summing the volumes of the pyramids to obtain a volume of the object.

1   7.   The method of claim 2 further comprising the step of receiving an input from a

2   user specifying a priority weight for a visual distortion factor, and the determining a

3   collapse value step further comprises, responsive to the computed visual distortion factors

4   and priority weights, determining a collapse value for the selected collapse path.

1   8.   The method of claim 2 wherein, responsive to collapsing the next vertex to be

2   collapsed along the corresponding collapse path, collapse paths local to the next vertex

3   are identified and the computing visual distortion factors for the selected collapse path

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4   and the determining a collapse value for the selected collapse path steps are repeated only

5   for the local collapse paths.

1   9.   The method of claim 2 wherein determining a set of collapse paths further

2   comprises:

3   selecting a target vertex;

4   receiving input specifying a maximum number of neighbor vertices for a

5   target vertex;

6   identifying a number of neighbor vertices, responsive to the received

7   input;

8   determining a collapse path responsive to coordinates of the target vertex

9   and an identified neighbor vertex;

10   repeating the determining step for all identified neighbor vertices;

11   repeating the selecting a target vertex, identifying, determining, and

12   repeating steps for a plurality of vertices.

1   10.   The method of claim 2 further comprising the steps of:

2   responsive to selecting a collapse path, displaying the object prior to

3   collapsing the object along the selected path;

4   collapsing the object along the specified path;

5   displaying the object after being collapsed along the specified path;

6   responsive to receiving an input selecting the collapse path, storing the

7   collapse path and corresponding vertex on the collapse order list as

8   the next vertex to be collapsed.

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1   11.   The method of claim 1, further comprising receiving an input specifying a set of

2   minimum vertices, and the determining collapse order step further comprises determining

3   a collapse order in which the specified set of minimum vertices are not collapsed.

1   12.   The method of claim 1 wherein multiple resolution levels of the object exist,

2   further comprising the steps of:

3   ordering the resolution levels from highest to lowest resolution;

4   selecting a highest resolution level for collapsing;

5   the determining a collapse order step comprises determining a collapse

6   order for the highest resolution level, wherein vertices in the next

7   lowest resolution level are not collapsed; and

8   repeating the selecting and determining steps for each resolution level.

1   13.   The method of claim 1 wherein the vertex coordinates are associated with vertex

2   attributes.

1   14.   The method of claim 2 wherein the vertices have coordinates in a texture map,

2   further comprising the steps of:

3   responsive to a selected collapse path collapsing a first vertex into a

4   second vertex to create a new vertex, assigning the texture map

5   coordinates of the second vertex to the new vertex;

6   responsive to the first and second vertex being on an edge of a texture

7   discontinuity, identifying the collapse path as a collapse path not to

8   be used.

1   15.   The method of claim 2 wherein the vertices have coordinates in a normal map,

2   further comprising the steps of:

3   responsive to a selected collapse path collapsing a first vertex into a

4   second vertex to create a new vertex, assigning the normal map

5   coordinates of the second vertex to the new vertex.

1   16.   The method of claim 2 wherein the vertices have coordinates in a color map,

2   further comprising the steps of:

3   responsive to a selected collapse path collapsing a first vertex into a

4   second vertex to create a new vertex, assigning the color map

5   coordinates of the second vertex to the new vertex; and

6   responsive to the first and second vertex being on an edge of a color

7   discontinuity, identifying the collapse path as a collapse path not to

8   be used.

1   17.   A method for displaying an object, wherein a vertex list and a neighbor list is

2   stored for the object, and vertices in the vertex list are identified by a collapse priority,

3   and the neighbor list identifies the path of a collapse for the vertices, comprising the steps

4   of:

5   performing a collapse of the object responsive to the vertex list and

6   neighbor list;

7   storing vertex information for each collapse level, wherein the vertex

8   information indicates which vertices exist in the object in the

9   collapse level immediately higher and lower than the current

10   collapse level;

11   receiving input requesting a collapse level for the object;

12   responsive to the requested collapse level requiring a higher resolution

13   than a current collapse level, adding vertices to the vertex list for

14   the object responsive to the vertex list and stored vertex

15   information;

16   responsive to the requested collapse level requiring a lower resolution than

17   a current collapse level, collapsing vertices in the vertex list of the

18   object responsive to the vertex list and stored vertex information;

19   and

20   rendering the vertices in the vertex list to produce a three-dimensional

21   visual representation of the object.

1   18.   The method of claim 17 further comprising the step of:

2   storing extended collapse information, wherein the extended collapse

3   information includes triangle connectivity information for the

4   vertices.

1   19.   A method for displaying an object, wherein a vertex list and a neighbor list is

2   stored for the object, and vertices in the vertex list are identified by a collapse priority,

3   and the neighbor list identifies the path of a collapse for the vertices, comprising the steps

4   of:

5	performing a collapse of the object responsive to the vertex list and

6	neighbor list;

7	storing vertex information for each collapse level, wherein the vertex

8	information indicates which vertices exist in the object in the

9	collapse level immediately higher and lower than the current

10	collapse level;

11	analyzing the object to determine a collapse level;

12	responsive to the determined collapse level requiring higher resolution,

13	adding vertices to the vertex list for the object responsive to the

14	vertex list and stored vertex information;

15	responsive to the determined collapse level requiring a lower resolution,

16	collapsing vertices in the vertex list for the object responsive to the

17	vertex list and stored vertex information; and

18	rendering the vertices in the vertex list to produce a three-dimensional

19	visual representation of the object.

1	20.	The method of claim 19 wherein the step of analyzing the object further

2	comprises:

3	determining a velocity of the object; and

4	determining a projected area of the object.

1	21.	The method of claim 20 wherein the step of analyzing the object further

2	comprises:

3	determining the number of polygons currently being displayed;

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4   comparing the determined number to a predefined target number of

5   polygons; and

6   responsive to the number of polygons currently being displayed being less

7   than the predefined number, adding polygons to the object.

1   22.   The method of claim 19 wherein the step of analyzing the object further

2   comprises:

3   determining a current frame rate;

4   comparing the current frame rate to a predefined frame rate; and

5   responsive to the current frame being less than the predefined frame rate,

6   collapsing vertices in the object.

1   23.   A method for transferring data across a remote connection, in a system in which a

2   minimal resolution of an object is stored and separate packets of information comprising

3   data for creating higher resolutions of the object are stored, comprising the steps of:

4   receiving a request for a transmission of an object to be displayed;

5   transmitting a minimal resolution version of the object responsive to the

6   received request;

7   transmitting a packet of information comprising data for creating a next

8   higher resolution of the object;

9   determining whether a target resolution of the object has been met; and

10   responsive to a target resolution of the object not being met, repeating the

11   transmitting a packet of information comprising data for creating a

12   next higher resolution of the object step.